SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTIONS IN SOUTHEAST ASIA: A SYSTEMATIC REVIEW

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ABSTRACT

Background: This study attempts to review longitudinal school-based physical activity (PA) interventions in Southeast Asia countries.

Materials and Methods: ScienceDirect, PubMed and Scopus databases were used, which ranged from the years 2003 until April 2018. A total of twelve studies were included in the final review including seven from Malaysia, three from Singapore, one from Indonesia and one from Thailand.

Results: The findings from Malaysian studies showed that EPaL provides students with cognitive and behavioural skills to cause changes in targeted behaviours by aiming to alter disordered eating behaviour, promoting PA, preventing sedentary lifestyle and enhancing eating behaviours. The integration of the transtheoretical framework improves participant adherence. Furthermore, circuit training was implemented during PE classes. The results showed significant improvements in the reduction of BMI, cardiovascular endurance and flexibility. In addition, MASCOT is ideal for promoting health and reducing obesity in Malaysian children as it has shown to improve BMI and total PA. In the Indonesian study, low-intensity endurance exercise of lower extremity has shown improvements in lower-extremity endurance as well as V02 max before for individuals with lower physical capacity. In Thailand, child health promotion programme has been shown to reduce the percentage of obesity of school children in the long-term. Finally, exergaming in the Singaporean studies showed improvements in attitude, self-efficacy, and perceived behavioural control.

Conclusion: Limited studies were conducted on studying the cause of longitudinal PA implementation in school settings and its impact in Southeast Asia. Therefore, future studies are proposed to investigate this relationship and utilise comprehensive frameworks to identify domains for facilitating or inhibiting PA implementation.

Keywords: Physical activity, school, children, intervention, exercise, Southeast Asian.
1.0 Introduction

School administration often cites budget restrictions and the need to spend more time on academic subjects rather than physical education (Sibley & Etnier, 2003). The increased emphasis on standardised test performance has led to many educators believing that more time is needed for academic performance rather than physical education. However, physical educators believe that education should take up a more holistic approach, which includes both mental and physical learning. Recent studies have proven that physical activity in school settings has helped children by improving their cognitive abilities, attitudes and academic performance (Liu et al., 2018; Uzunoz et al., 2017). Therefore, the involvement of students in physical activity should be emphasised to achieve higher success both mentally and physically.

Physical activity is defined as any bodily movements by the skeletal muscles that resulted in energy expenditure (Caspersen et al., 1985). A subset of physical activity is exercise, which is defined as physical activity that is planned, structured, repetitive and purposeful for improving one or more components of health or skill-related fitness. Health-related fitness consists of five components: cardiorespiratory endurance, muscular endurance, muscular strength, body composition and flexibility. Skill-related fitness, however, consists of six components: agility, balance, coordination, power, reaction time and speed. Both health-related fitness and skill-related fitness components make up the attributes of physical fitness (Caspersen et al., 1985).

For children, participation in at least sixty minutes of moderate to vigorous physical activity per day is essential for their healthy growth and development (Nathan et al., 2017). A study conducted by Ching et al. (2015) reported that out of 233 Singaporean adolescents, none of them achieved the recommended 60 minutes of daily moderate-to-vigorous physical activity (MVPA) in a week. Furthermore, observations of 154 physical education lessons found that only 5% of schools in the United States adhered to mandated state policies that require 100 minutes of physical education to be taught each week (Thompson et al., 2013). In Canada, a study found that 43% of elementary school teachers reported implementing the mandatory daily 30 minutes of physical activity policy (Masse et al., 2013). Schools have been recommended as a key setting for the delivery of population-wide physical activity initiatives as schools provide universal access to children (WHO, 2008). As such, many governments have released guidelines or policies mandating a minimum accumulated time or intensity that the schools should adhere and to schedule a structured physical activity for children (Hardman, 2008; Harrington & et al., 2014; Masse et al., 2013; NSW Government, 2015).

The incidence of obesity has tripled in Malaysia since 1996, with one-third of the adult population currently overweight or obese. In 2011, 3.4% (0.3 million) children under the age of 18 years old, were obese (Ministry of Health Malaysia, 2011). In addition, Manan et al. (2012) stated that 13.1% of primary school students in Kota Bharu faced the problem of obesity. Thus, aside from major contributing factor such as diet, researchers have consistently indicated that schools fail to implement mandatory physical activity policies due to the lack of environmental resources such as equipment, time and staff; perceived priority of schools that adopt policies that gear students more towards academic achievement rather than physical education; social influences such as lack of support from school board to promote physical
activity interventions, and inadequate skill of the teachers to implement physical activity interventions (Kueh et al., 2018; Nathan et al., 2017). To address this issue, a well-thought and systematic school-based physical activity intervention that counteract such deficiencies should be implemented. Therefore, the aim of this review is to explore suitable physical activity interventions implemented in school settings across Southeast Asia.

2.0 Materials and Methods

2.1 Search strategy

Table 1 below demonstrates the search strategy for school-based physical activity intervention in Southeast Asia. This study is a systematic review for implementing physical activity intervention in Southeast Asia schools. The research designs of these studies were longitudinally based and are conducted in both primary and secondary schools. The keywords used in this review were physical activity, school, children, adolescence, exercise, intervention, Southeast Asia, Malaysia, Singapore, Thailand, Brunei, Indonesia, Laos, Myanmar, Cambodia, Philippine, Vietnam and Timor-Leste. The online databases used during the literature search were PubMed, ScienceDirect and Scopus. The dates of the journal ranged from the years 2003 until April 2018 spanning up to 15 years. Figure 1 below demonstrates the inclusion and exclusion of the studies in this review.

Table 1: Search strategy for on school-based physical activity interventions in Southeast Asia

<table>
<thead>
<tr>
<th>Field One (combine with OR) –Population, country</th>
<th>Field Two (combine with OR) – Demographic</th>
<th>Field Three (combine with OR) - Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keywords: Southeast Asia, Malaysia, Thailand, Singapore, Brunei, Indonesia. Timor-Leste, Philippine, Vietnam, Cambodia, Laos, Myanmar</td>
<td>Keywords: School, children, adolescence</td>
<td>Keywords: Physical activity, exercise, intervention</td>
</tr>
</tbody>
</table>

2.2 Data extraction

The process of extraction of relevant data was performed by one researcher and cross-checked by the second and third researchers. The variables extracted were demographic details such as age, gender, and country of origin. Besides that, the intervention and its process were also extracted along with the outcomes of the study based on the study objective. In addition, the frequency, intensity, type and time (FITT) principle were also extracted and subsequently used in the comparative analysis in this review. During the data extraction process, eligibility was again checked, and appropriate inclusion or exclusion action was taken. Any difference of opinion between researchers during the review process was resolved by discussion and
consensus. In the outcomes, mean and standard deviation are stated. Where possible, units were standardised by simple mathematical conversion.

![PRISMA diagram: inclusion and exclusion of papers in this review](image)

**Figure 1:** PRISMA diagram: inclusion and exclusion of papers in this review

**2.3 Eligibility criteria**

Eligibility criteria were established by the researchers prior the search by identifying school-based interventions of both primary and secondary schools throughout Southeast Asia. Original field observational studies and quasi-experimental study designs, presenting data on the effect of physical activity with or without other interventions such as diet and counselling among school-children were considered for the review. Studies were considered suitable for inclusion if they involved school children in school settings. Studies that are conducted on school children but at other settings such as homes and hospitals are excluded. Furthermore, pre-school children and college students are also not included in this review. After duplicates were removed, the titles, abstracts, and full articles were reviewed by three researchers against the eligibility criteria.
## 3.0 Result

### Table 2: Summary of studies, FITT and outcome of interventions

<table>
<thead>
<tr>
<th>Authors (years)</th>
<th>Participants (N, gender, age, country)</th>
<th>Intervention (exercise, diet &amp; theory used)</th>
<th>Length of study</th>
<th>Frequency per week (duration)</th>
<th>Intensity</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wong et al. (2008)</td>
<td>N=24, male, 13-14 years old, Singapore</td>
<td>Combination of circuit-based resistance training and aerobic exercise (FITT principle)</td>
<td>12 weeks</td>
<td>Twice a week (45-60 mins)</td>
<td>65-85% max. HR</td>
<td>After: N^4 (SD^5): BMI EG= 29.4 (2.8), BMI CG = 31.7(4.4) Systolic BP: EG= 113.8(7.1), CG = 117.0(6.2) Resting HR: EG=71(2.5), CG = 76(3.9) Exercise HR (stage 3): EG = 139(11.9), CG = 149(8.5)</td>
</tr>
<tr>
<td>Wafa et al. (2011)</td>
<td>N=107, male &amp; female, 7-11 years old, Malaysia</td>
<td>Malaysia Childhood Obesity Treatment Trial (MASCOT) Parents as premier agent of change (theory)</td>
<td>12 weeks</td>
<td>Once a week (60 mins)</td>
<td>Low-intensity / counselling</td>
<td>Between group diff: N^4 (95% CI), P-value BMI z score: -0.09(-0.32, + 0.30), .79 Weight: -1.9 (-0.8, -2.8), &lt;.01 Total PA: +16 (-53, +86), .64 Moderate-vigorous PA: +0.5 (-0.1, +1.2), .11 Sedentary behaviour: -1.2 (-3.3, +1.0), .29 Total QOL (parent): +8.0 (+0.3, +15.8), .04 Total QOL (child): +6.3 (-0.2, +12.7), .05</td>
</tr>
<tr>
<td>Rengasamy (2012)</td>
<td>N=86, female, 16 years old, Malaysia</td>
<td>Circuit training (4 types of exercises)</td>
<td>10 weeks</td>
<td>Twice a week (40 mins)</td>
<td>Not stated</td>
<td>CE^1: F (1, 83) = 44.69 F^2: F (1, 83) = 46.80 MS^3: F (1, 83) = 3.54</td>
</tr>
</tbody>
</table>

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Rengasamy et al. (2014)  
N=173, male& female, 16 years old, Malaysia  
**Circuit training** (4 types of exercises)  
(FITT principle)  
10 weeks  
Twice a week  
30 secs per exercise  
Boys: F (1, 84) = 18.17  
Girls: F (1, 83) = 44.69

Lwin and Malik (2014)  
N=398 male& female, 10 years-old, Singapore  
**Exergaming and PHM**  
integrated in to the TPB SDT  
6 weeks  
Once a week  
PE classes (control) – moderate PA  
Exergame + PHM:  
Attitude, F (1,392) = 4.92, p<.05  
Self-efficacy, F (1, 392) = 5.41, p <.05  
PBC, F (1, 393) = 3.23, p=.07

Salimin et al. (2015)  
N=40, male& female, 8 years old, Malaysia  
**Healthy Lifestyle Program Manual National Service**  
(18 low, 40 moderate & 14 high intensity)  
8 weeks  
5 times/week  
Low-high  
Before: N^4 (SD^2) weight = 24.91 (0.9)  
After: N^4 (SD^2) weight = 23.60 (0.9)

Leong et al. (2015)  
N=81, female, 16 years old, Malaysia  
Aerobic exercise &/or milk consumption  
Exercise and diet  
6 weeks  
Twice a week  
70% maximal HR (moderate to vigorous)  
Digit Span Test:  
(F3 = 5.11, p < .01)

Tamin et al. (2015)  
N=212, male and female, 10-30 years old, Indonesia  
**Endurance exercise**  
Low intensity workout  
16 weeks  
Three times per week  
Moderate  
N^4 (SD^2)  
Lower extremity endurance level  
Month 1: Group A:1.20(0.24), Group B:1.15(0.37), Group C:1.18(0.44), p=0.81  
Month 4: Group A:2.22(0.22), Group B:2.76(0.38), Group C:1.58(0.44), p=0.00  
VO2 Max prediction  
Month 1: Group A: 32.72(5.14), Group B: 32.22(5.88), Group C: 32.22(5.88)
Elumalai et al. (2016)  
N=40, female, 16 years old, Malaysia  
Circuit training (6 types of exercises) (FITT principle)  
8 weeks  
Thrice a week (36 mins)  
60-90% of max HR  
Before: N^4 (SD^5) BMI = 26.24 (2.29)  
After: N^4 (SD^5) BMI = 24.88 (2.28)

Sharif et al. (2016)  
N=72, male & female, 16 years old, Malaysia  
EPaL (counselling and skill learning)  
Transtheoretical framework theory  
16 weeks  
Once a week (60-90 mins)  
nil-

Lwin et al. (2016)  
N=595 male & female, 8 to 17 years old, Singapore  
Exergaming and PHM^6 integrated in to the TPB\(^7\)  
SDT\(^{11}\)  
7 weeks  
Once a week (60 mins)  
Exergaming (intervention) greater energy expenditure than PE  
PE classes (control) – moderate PA

Cardiovascular endurance\(^1\), Flexibility\(^2\), Muscular Strength\(^3\), Mean\(^4\) & Standard Deviation\(^5\), Persuasive Health Message\(^6\), Theory of Planned Behaviour\(^7\), Perceived Behavioural Control\(^8\), Competitive Intrinsic PHM\(^9\), Non-competitive Extrinsic PHM\(^{10}\), Self-determination Theory\(^{11}\)

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3.1 Search results

The initial database search yielded 2340 studies in which, only 23 were relevant studies. After conducting the title and abstract screening, 9 of the relevant studies were excluded. Further full-text screening resulted in 2 more studies being excluded, leaving only 12 studies included in this review. The paper from Thailand focused on the group-based intervention of childhood obesity, which was initially included in this review (Santiprabhob et al., 2014), however, the study was conducted in a hospital setting, and therefore was excluded. Besides that, the paper from Singapore used acute sprint interval exercise in a laboratory setting (Burns et al., 2012). Although this exercise itself can be implemented in a school-based physical activity intervention, the use of a cycling ergometer for exercise will be impractical for many students. Thus it was also excluded. A summary of each study’s protocol is presented in Table 2.

3.2 Study characteristics

Participants in all the included studies were male and female. The age was varied between studies but was generally between 8 to 17 years old with one study ranging from 10 to 30 years old as the school provided education for people with disability from young to old. The participants BMI were normal but in a few of the studies, were overweight and obese.

4.0 Discussion

4.1 Circuit training and FITT

Table 2 summarises the frequency, intensity, type and time (FITT) of each intervention as well as the outcome in each of the reviewed studies. In the Malaysian study conducted by Rengasamy (2012), a total of 86 females aged 16 years old were recruited for a physical fitness program to measure their health-related fitness specifically flexibility, cardiovascular endurance and muscular strength. The intervention was circuit training as suggested by Morgan and Adamson (1972) with four different exercises, however, the type of exercise and intensity is not stated in the study. The intervention lasted for ten weeks and conducted twice a week with each session lasting 40 minutes. After ten weeks, post-test data were collected. From the analysis, ANCOVA indicated that there was a main effect in cardiovascular endurance \( F(1, 83) = 44.69, p<.05 \) and for flexibility \( F(1, 83) = 46.80, p<.05 \). As for muscular strength, the result was not significant \( F(1, 83) = 3.54, p> .05 \). The results of the intervention showed significant improvements in enhancing cardiovascular endurance and flexibility among the intervention group. Improvements in flexibility and cardiovascular endurance can be acquitted to increase training volume. However, muscular strength showed no significance difference, which may be attributed to the insufficient intensity and the non-compliance of the progressive overload principle (Rengasamy, 2012).

Rengasamy et al. (2014) conducted another similar study two years later to evaluate the effect of employing physical fitness intervention on cardiovascular endurance among Malaysian male and female secondary school students aged 16 years old. The four exercises included were shuttle run, burpee, jumping jacks and modified sit-ups. Each exercise was conducted
for 30 seconds with a rest interval of 30 seconds. The rest interval was reduced to 25 seconds as the overload principle after the fifth week as suggested by Morgan and Adamson (1972). The control group participated in regular physical education classes. Post-test data were collected after ten weeks. Analysis using ANCOVA indicated that there was a main effect in cardiovascular endurance $F(1, 84) = 18.17, p < 0.05$; Cohen $d = .17$ between the boys and a main effect $F(1, 83) = 44.69, p < .05$; Cohen $d = .35$ between the girls. The results showed that the experimental group was effective in enhancing the cardiovascular endurance among the groups of boys and girls (Rengasamy et al., 2014).

Physical education is conducted twice a week in most schools in Malaysia with duration of 40 minutes a session as directed by the Ministry of Education. This may have fulfilled the minimum duration and the frequency levels required, but lack the sufficient intensity level to accomplish the total training volume to enhance cardiovascular endurance as shown by the control group of males and females (Rengasamy et al., 2014). The duration is still lacking in accordance to the physical activity guideline set by the United States Department of Health and Human Services (1996), which is at least 30 minutes of moderate physical activity on most days of the week. Intervention programs within physical education classes are effective in improving cardiovascular endurance and flexibility due primarily to the increased duration of physical activity. It is strongly suggested that physical educators and curriculum planners introduce intervention programs within regular physical education as it is seen necessary to increase the intensity level which is sufficient to improve selected cardiovascular endurance among the Malaysian school students (Rengasamy et al., 2014). Furthermore, engagement in circuit training is considered safe as no injury was observed during the intervention.

In another unrelated study, physical education in the form of circuit training was also used to evaluate its effectiveness on the level of body mass index (BMI) of 40 purposely sample form four overweight and obese female students from SMK Taman Bukit Maluri, Kuala Lumpur (Elumalai et al., 2016). The circuit training intervention for this study was specially planned based on the frequency, intensity, type and time (FITT) principle by giving emphasis on the intensity and frequency with a minimum of 20-30 minutes per session, three times a week and at the intensities of 60 to 90% from the maximum heart rate (Elumalai et al., 2016). The circuit consisted of 6 exercises in which students completed each exercise in 1 minute and had a rest interval of 1 minute. The participants had to complete four sets of exercises. The ratio for this exercise to rest interval is one-to-one (1:1). In addition, based on the progressive overload principle, intensity and heart rate were gradually increased on the fourth week by increasing the duration for each set to one minute and thirty seconds and the shortening of the rest interval to thirty seconds. This will increase the difficulty of the sets, which in turn would lead to changes to the participant’s physiology and therefore help their body to adapt. Due to the increased level of energy, an increase in intensity is needed to overcome the energy balance to further lose weight and avoid stagnation or the ceiling effect. Figure 2 below demonstrates the summary of relationships between circuit training, FITT principles and its outcome of the studies conducted on circuit training.

In the study conducted by Wong et al. (2008), exercise programme comprised a combination of circuit-based aerobic exercises, strength conditioning and/or resistance training, and game activities such as soccer, handball, stair-climbing exercises and other active recreational activities involving continuous work bouts maintained on average at 65% to 85% of
maximum heart rate. However, the training programme started with a training intensity of 50% to 60% maximal heart rate in the first 2 weeks of the programme to ensure that participants developed a sense of success and positive self-esteem early in the programme (Owens & Gutin, 1999). The intensity and duration of the exercise programme were gradually and progressively increased, as individually tolerated, to induce a training effect throughout the 12-week period (Wong et al., 2008). The sessions were initiated and ended with a 7 to 10 minute warm up and cool-down. The results showed significant improvements in lean muscle mass, body mass index, fitness, resting heart rate, systolic blood pressure and triglycerides. However, it is felt that a 12-week additional twice weekly exercise training may not be sufficient to result in improvement on the parameters related to adiposity and risk factors for cardiovascular and metabolic diseases, suggesting the need of higher intensity and/or a combination with dietary intervention to achieve desirable health effects (Wong et al., 2008).

**Figure 2**: Summary of FITT for circuit training and the outcome

The results indicate a significant difference in the mean score between pre-test mean \( (SD) = 26.24, (2.29), p = .001 \) and post-test mean \( (SD) = 24.88, 2.28, p = .001 \) for the intervention group. The result proved that the intervention program was successful in giving significant effects towards the body fat percentage and manage to reduce BMI of the treatment effectively (Elumalai et al., 2016). In addition, there was also significant difference between the intervention group mean \( (SD) = 24.88, (2.28), p = .001 \) and control group mean \( (SD) = 26.15, (1.14), p = .001 \). The outcome shows that the specially designed circuit training program could be used as a physical activity to reduce BMI compared to normal physical activities during school physical education classes (Elumalai et al., 2016).

Based on the results of this study, the circuit training intervention showed a positive effect on the level of body fat among obese female students in the intervention group. The results of this study were consistent with the study conducted by O’Connor et al. (2015) who conducted...
research by using the physical intervention programme for six weeks to increase the cardiovascular fitness among 16 years old obese teens in which the findings had reported that this method was effective in reducing fat around the waist and the insulin levels among the research participants. Findings from these studies also indicated that a combination of 3 or more types of training was sufficient in inducing a positive effect towards a reduction in body weight (Elumalai et al., 2016).

4.2 Integrated theoretical framework in a physical activity intervention

The Malaysian Childhood Obesity Treatment Trial (MASCOT) was adapted from the Scottish Childhood Obesity Treatment Trial (SCOTT) and was delivered as a group intervention targeting the parents only unlike SCOTT (Hughes et al., 2008) which targeted both parents and children. Modifications to the SCOTT treatment program were made to use the parents as the main agents of change which have turn out to be successful in some studies (Golan et al., 2006; Luttikhuis et al., 2009). The strengths of this study were the high-level evidence obtained, with adherence to the consolidated standards of reporting trials (CONSORT) statement on conducting and reporting of the randomised controlled trial (RCT) (Schulz et al., 2010); inclusion of a large number of study outcomes; and completing a challenging childhood obesity treatment RCT (Warren et al., 2007), in the novel setting of a low-middle country (Wafa et al., 2011). Longer-term outcome measures would have been useful to assess the sustainability of intervention effects on weight status, and it is suggested to include longer-term follow up in future studies; an assessment of parents and child perspectives on treatment program; dietary assessment and cardio metabolic risk factors assessment were not undertaken- these were not feasible given resource constraints, for future study. Moreover, the trial was directed at parents who perceived their children’s weight status as a problem, and treatment interventions aimed at parents who might not recognise that their children are obese would be important in the future (Wafa et al., 2011). The focus of treating participating children might also be important in future interventions, but this was not feasible due to the limited resources.

In the study conducted by Lwin and Malik (2014), two types of intervention, exergaming and persuasive health messages (PHM) were used to encompass both behavioural and cognitive intervention. Exergame is the use of video game consoles to exercise by tracking the movement and reaction of a persons’ body. The inclusion of the exergaming into children’s physical education (PE) lessons improved their confidence in performing physical activities, and in turn lead to more positive self-efficacy, attitudes and perceived behavioural control (Lwin & Malik, 2014). In addition, the cognitive approach which integrates the theory of planned behaviour confirm previous findings on the effectiveness of coping-framed messages in influencing physical activity beliefs (Courneya & Hellsten, 2001; Graham et al., 2006).

Later, Lwin et al. (2016) conducted another study on exergaming and PHM while focusing more on the difference in effects of physical activity beliefs between children and adolescence as well as intrinsic and extrinsic PHM from self-determination theory (SDT) perspective. The children showed significant improvement in combined effects of school group environment SDT-based health education messages on attitudes and intention while the adolescence did not. The limitations of this study include short duration period which may explain the non-significant findings of the first study regarding physical activity intention, subjective norm and group norms as well as brief exposure to the intervention component in which students
were only able to participate in the exergame once a week. In short, as exergames are a fusion of games and exercise, exergames may initially attract students to be more physically active because of the fun and enjoyment associated with the games in which over time, students may develop more positive attitudes toward exercise and exercise more (Lwin et al., 2016).

In Thailand, the Bright and Healthy Thai Kid Project was initiated from May 2004 until January 2005 in which a participatory action initiative was used that involved teachers, parents and students to promote health (Sirikulchayanonta et al., 2011). The total number of students reached 5126 from 4 Bangkok schools. The project was integrated into the regular course curriculum and was delivered by the teachers who were given prior knowledge via workshop. In the workshop, teachers were given lessons in causes and consequences of childhood obesity, child nutritional assessment, eating right, exercise and health as well as weight management. An interesting finding before the intervention was the fact that Thai mothers did not perceive their child’s overweight status to be an issue, rather, they believed it to be healthy (Sirikulchayanonta et al., 2011). In addition, parents had a more positive social attitude about eating due to fast food advertisements, which had high contents of fat and low fibre. The study intervention helped reduce the high-caloric dietary intake significantly in both the obese and normal groups. Light-intensity exercise in the form of walking up the stairs showed a significant percentage increase from 82.1 to 90.9 ($p = .001$) for the normal group while the obese group also increased from 83.6 to 86.6 ($p = .001$). Aerobic exercises such as fast walking, running and aerobic dance all showed significant percentage decrease in obesity after the intervention, school A before = 19.6, after = 16.6, $p < .05$; school B before = 21.4, after = 19.2, $p = .066$; school C before = 18.4, after = 15.6, $p < 0.5$ and finally; school D before = 17.6, after = 15.7, $p = .174$. The schools shared similar demographics for gender, the number of students and family socioeconomic status, parental support and school environment.

4.3 Physical activity intervention as a tool to overcome overweight and obesity

The following study was conducted by Salimin et al. (2015) to evaluate the effectiveness of eight weeks physical activity program among obese students of SJK (T) Barathi, Hutan Melintang. A total of 40 students (male, $n = 20$; female, $n = 20$) were recruited in this study. The program was based on the Healthy Lifestyle Program Manual National Service (Salimin et al., 2016). The intervention program consisted of 18 low intensity activities, 40 moderate intensity activities, 14 high intensity activities, and 8 relaxation therapy sessions spread out in the duration of 8 weeks. The goal of this intervention is to address the issue of healthy lifestyles among Malaysian. The level of obesity is shown in Table 3 which was based on the Asia World Health Organisation 2004 norms (Salimin et al., 2015).

The findings showed that there was a significant reduction in weight as the overall mean of the program, mean ($SD$) =24.91 (0.9), $p = .001$, which has been reduced to mean ($SD$)=23.60 (0.9), $p = .001$ after the intervention. Before the intervention, 38 participants (95%) of the participants were pre-obese and two participants (5%) were obese. After the intervention, seven participants (17.5%) were normal and 33 participants (82.5%) were pre-obese. The findings of this study were consistent with the study conducted by Gunathevan et al. (2013), which showed a positive reduction in weight by facilitating the activities provided by the Manual Healthy Lifestyle National Service within an eight-weeks’ timeline. Furthermore, there was no difference in the mean obesity scores between the males and females. Consistent
with the study conducted by Siew (2010), in which the intervention program is influenced by demographic, psychosocial and working times as lead factors causing obesity among males and females (Salimin et al., 2015).

Table 3: Level of obesity (BMI) for pre- and post-tests

<table>
<thead>
<tr>
<th>Kg/m²</th>
<th>Level</th>
<th>No. of Participants (%)</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18.5</td>
<td>Underweight</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>18.5–22.9</td>
<td>Normal</td>
<td></td>
<td>-</td>
<td>7 (17.5)</td>
</tr>
<tr>
<td>≥ 23.0</td>
<td>Overweight</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>23.0–27.4</td>
<td>Pre-obese</td>
<td></td>
<td>38 (95.0)</td>
<td>33 (82.5)</td>
</tr>
<tr>
<td>27.5–34.9</td>
<td>Obese Class I</td>
<td></td>
<td>2 (5.0)</td>
<td>-</td>
</tr>
<tr>
<td>35.0–39.9</td>
<td>Obese Class II</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>≥ 40.0</td>
<td>Obese Class III</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>40 (100)</td>
<td></td>
</tr>
</tbody>
</table>

The school-based intervention to prevent overweight and disordered eating in secondary school Malaysian adolescents was conducted by (Sharif et al., 2016) at two schools in Hulu Langat, Selangor. Adolescents aged between 13-14 years old were recruited. A peer-education strategy was adopted to convey knowledge and teach skills relevant in achieving a healthy lifestyle in which the intervention mainly promoted: healthy eating, positive body image and active lifestyle (Sharif et al., 2016). The intervention is known as ‘eat right, be positive about your body and live actively’ (EPaL). The parameters assessed were body weight, disordered eating status, stages of change (for healthy diet, breakfast, food portion size, and screen viewing and physical activity), body image, health-related quality of life, self-esteem, eating, physical activity behaviours as well as knowledge, attitude and practice towards a healthy lifestyle. The assessments were conducted at three-time points: baseline, post-intervention and 3-month follow-up.

EPaL provides students with cognitive and behavioural skills to effect the changes in targeted behaviours by aiming to alter disordered the eating behaviour, promote physical activity, prevent sedentary lifestyle, encouraging eating in all meal time, consumption of fruits and vegetables and lowering sweetened beverages intake (Sharif et al., 2016). The intervention also integrated the transtheoretical framework by categorising the adolescents into stages of change in which the cognitive and behavioural adaptions were made for them to adhere to the intervention. The main constructs of the transtheoretical model are the stages of change, processes of change, decisional balance, and self-efficacy. In the 10-week of intervention however, limited studies have been found for the use of the transtheoretical framework on younger participants such as primary school children. A minimum of 12 weeks is required to see any measurable effects.
In addition, physical activity assessment was based on activity recall in which adolescents were asked to recall activities such as sitting, walking and standing every fifteen minutes during a 24-hour period. Each activity was assigned with a calculated metabolic equivalent (MET) in which the total energy expenditure was derived by including the duration of activity and body weight of the adolescents. The physical activity level (PAL) of the adolescents were then calculated by dividing the total energy expenditure by the basal metabolic rate (BMR) and was classified in to four categories: Sedentary (PAL < 1.40), light (PAL = 1.40–1.69), moderate (PAL = 1.70–1.99) and vigorous (PAL = 2.00–2.40) (Food and Agriculture Organization, 2005).

The study was designed to assess the perceptions towards healthy eating habits, body size/shape and physical activity. There was no direct physical activity intervention implemented, rather the study focused on a more psychological intervention to promote physical activity. The intervention lasted for sixteen weeks in which sessions lasted for sixty to ninety minutes and conducted once a week. However, the study was still retrospectively registered and therefore no results were collected. Discussions of previous studies indicated on EPaL’s contribution in preventing overweight and disordered eating by giving positive effects on body weight status, healthy lifestyle behaviour as well as health-related quality of life peer educators and participants (Sharif et al., 2016). Thus, this may also serve as a model for future implementations in the Malaysian school settings, specifically on adolescents.

The quality of life (QoL) is expected to significantly improve in peer educators and participants after the implementation of the program (Sharif et al., 2016) as generally peer educators testified that peer-led approach gave them a valuable opportunity for personal development and learning by building the young people’s skills and abilities (Story et al., 2002) as well as promoting healthy lifestyle practices (Birnbaum et al., 2002). In addition, the integrated program for both tackling obesity and eating disorder issues via physical activity and food intake components decreased the duration and made the program more cost-effective compared to separate programs (Neumark-Sztainer, 2005). However, limitations for this study include randomisation was only performed when selecting the schools, and recruiting participants and assigning peer educators would be more favourable and may a produce higher level of confidence in term of the validity and causality of the programme’s effectiveness (Cottrell & McKenzie, 2011).

4.4 Physical activity and cognitive development

Another study conducted by Leong et al. (2015) on aggregated effects of combining daily milk consumption and aerobic exercise on short-term memory and sustained attention among female students. There were 81 female students were recruited with the mean age of 16 years old in the Eastern state of Malaysia. They were randomly assigned into four groups: intervention groups (milk, exercise, and combination of milk and exercise) and control group. The measures used in present study including Physical Activity Questionnaire for Adolescents (PAQA) used by Kowalski et al. (1997) that was used for measuring the physical activity of participants; Food Frequency Questionnaire (FFQ) that was used to screen participants for how they consumed dairy products such as low-fat milk, full cream milk, milk powder, yogurt, cheese, and ice-cream; Revised Physical Activity Questionnaire (PAR-Q; (Thomas et al., 1992) that was used to assess the readiness of participants before initiating
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Physical capacity on young adults with intellectual disability (ID) measured by 20-meter running test was lower compared with non-ID (Pitteti & Fernhall, 2004). This can cause limitations to perform daily activities with excessive fatigue and decreasing the quality of life. Therefore, methods of exercise that increase the levels of lower extremity muscles endurance and cardiorespiratory endurance are needed, and the results are measured objectively (Tamin et al., 2015). In Indonesia, a model for endurance exercise training was conducted to increase physical fitness in intellectually disabled individuals with obesity. The exercise was conducted three times a week focusing on three types of exercise. The intensity was determined using repetition maximum (RM) which is the maximum repetition that can be achieved by a single try. Type I was a lower extremity muscles endurance exercise for 20 RM followed by a cardiorespiratory endurance exercise for 24-25 minutes, type II was a lower extremity muscles endurance exercise for 10 RM followed by a cardiorespiratory endurance exercise for 26-27 minutes, and type III (control group) threw a tennis ball with 10 m distance for 10 minutes (Tamin et al., 2015). The results showed that type II endurance exercise model was more effective in increasing lower extremity muscles endurance level compared to type I and III for ID patients with obesity \(p < .05\). The guidelines included were safety, selection, development, progression and motivation.

### 4.5 Moving forward

From the literature reviewed, the ideal interventional strategy for physical activity promotion that was identified as cost-effective is a school-based intervention for children and adolescents (Abu-Omar et al., 2017). The school environment is ideal for implementing physical activity interventions due to the possibility to reach a wide number of children who are spending most of their time in schools (Hills et al., 2015). Presently, research on the implementation of school-based physical activity programs indicated positive improvements on cognitive skills and attitudes, academic performance and academic behaviour with only a few studies indicating negative relationship (Mura et al., 2015). Physical activity is also important in reducing body fat, which is the prime factor for many non-communicable diseases. Therefore, more research is required to investigate the effect of school-based physical activity to support the effort of initiating policies for promoting positive changes at
decision-making levels aiming at providing children with more regular access to physical activity in school settings (Uzunoz et al., 2017). In addition, emphasis must be placed on finding new ways to promote physical activity and encourage behaviour change to perpetuate physical activity participation among children by making it interactive, fun, and engaging.

Besides that, The Global Community Health (GCH) foundation had recently introduced the Brain Breaks® Physical Activity Solutions or simply brain-breaks, an exercise video which can assists students’ development in learning and health. The aim of the GCH foundation is to expand the successful implementation of globally recognised, evidence-based health and wellness programs to the local communities while respecting the local culture and customs (GCH foundation, 2017). The implementation has already been conducted in schools in Turkey, Macedonia, Poland and more recently, Malaysia (Glapa et al., 2018; Kuan et al., 2019; Popeska et al., 2018; Uzunoz et al., 2017). The intervention is moderate to vigorous intensity physical activity aimed at improving health-related fitness such as cardiovascular endurance, muscular strength, muscular endurance, flexibility and body composition (Kuan et al., 2019). However, future study is required to evaluate the effects of this intervention in schools in Southeast Asia.

5.0 Conclusion and recommendation

In short, upcoming studies assessing factors that influence school implementation of physical activity policies would benefit from using a comprehensive framework to help identify domains for facilitating or inhibiting implementation of physical activity (Glowacki et al., 2017). Circuit-based training with FITT has proven as an effective tool to plan and implement a physical activity intervention. Physical activity in the form of circuit training and exergaming can be used in school to motivate students to participate more in physical activity. In regard to the theoretical framework, the SDT has shown improvement in attitude and beliefs in younger students. In addition, a transtheoretical framework may help in identifying the levels of the students’ motivation of students in wanting to participate in physical activity. However, limited studies have been conducted using the transtheoretical model on the younger population. Hence, future study is needed to evaluate the use of the transtheoretical framework in school settings. Finally, in addition to proper diet, improvements in health-related fitness would allow students to be healthier both physically and mentally.

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Declaration

Authors declare that there was no conflict of interest.

Authors’ contribution

HR and MSH conducted the literature search, analysed and interpreted the data; GK analysed, interpreted and approved the submitted data; all authors wrote the paper.

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